Lake Trout Stocking Assessment Dickey Lake 1981-1985

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INTRODUCTION

We undertook this study to assess the lake trout stocking program on Dickey Lake and explore the applicability of assessment unit information to stocking assessment. Fisheries assessment units can provide feedback to managers to determine if stocking programs are meeting their objectives. Furthermore, such assessments may identify information needs, that if met would increase management applications of assessment unit intelligence.

The Dickey Lake lake trout fishery was selected for study since it had a reasonably complete assessment data base, and is the subject of an extensive supplemental stocking program. Dickey Lake (44^{o} 47'N,77^{o} 44'W) is a 214 ha two basin Lake located in Lake Township, County of Hastings. Selected morphometric and limnological information is shown in Table 1. The Lake supports a winter, spring, and summer lake trout fishery and a summer smallmouth bass/largemouth bass fishery. The lake trout in Dickey Lake are planktivorous. Total mean annual lake trout fishing effort (1981-85) was 21.6 angler-hrs/ha. Total annual yield of lake trout (native and planted fish) has averaged 1.12 kg/ha/yr.

Table 1. Selected morphometric and limnological information for Dickey Lake.

Surface area:	214 ha	Secchi depth:	5.1 m
Mean depth:	18.3 m	Maximum depth:	54 m
Total dissolved solids:	90 mg/L	Morphoedaphic Index:	4.9
pH:	7.4	Alkalinity:	54 mg/L
Total Phosphorous:	0.007 mg/L	Total Nitrogen:	0.44 mg/L

The objective of the lake trout stocking program in Dickey Lake is to supplement the existing fishery by providing additional angling returns above those provided through natural reproduction. Planting rates in Dickey Lake have been relatively consistent since 1974, with the exception of a high rate in 1984 (Table 2). Size at planting varied between years with those of 1974 and 1975 being atypically small, and that of 1982 being exceptionally large (Table 2). The fish stocks have primarily been of Lake Manitou origin, having been raised in White Lake, Pembroke, and Westport hatcheries. Prior to 1977 all planted fish were transported to Dickey Lake by aircraft (K. Steale pers comm.). Beginning in 1977, fish were transported to the lake by hatchery truck.

Table 2. Lake trout plantings in Dickey Lake since 1974.

YEAR	# PLANTED (no.)	RATE (no./ha)	RATE (kg/ha)	AGE (mnths)	MEAN WT* (g)	CLIP	ORIGIN
1974	1250	5.84	0.07	15	11.4	LV	Lk. Manitou
1975	800	3.74	0.04	15	11.4	RP?	Lk. Superior
1977	1650	7.71	0.12	16	15.1	AD	Lk. Manitou
1981	1550	7.24	0.09	14	12.5	RP	Lk. Manitou
1982	1500	7.00	0.15	15	21.4	RV	Lk. Superior
1983	1500	7.00	0.11	17	15.1	AD	Lk. Manitou
1984	3030	14.15	0.23	15	16.2	LV	Lk. Manitou
1985	1500	7.00	0.12	15	17.0	LP	Lk. Manitou

* variance unknown

METHODS

We monitored catches of native and planted fish through creel surveys conducted from winter 1981 to winter 1985. Coverage was complete except for a delayed spring survey in 1981, and the complete

absence of a survey during the 1983 open water season. The creel survey design was a stratified roving design (Lester and Trippel 1985). Methodological details can be found in Loftus (1982). Planted fish were recognized by the presence of a stocking fin clip. Unclipped fish were assumed to be native. All fish were aged by scales.

Planted year-classes with the same clip were distinguished by size or scale age. There is no record of the clip given to the 1975 year-class of planted fish. However, scale ageing of a few large planted lake trout suggested that the 1975 cohort had a right pectoral clip, and these fish were assumed to have originated from this planting. The return of each individual year-class was estimated by multiplying its relative ocurrence in the sampled catch (% by number) by the estimated harvest. For the 1983 open water season harvest, the relative ocurrence of each year-class was estimated as the average of the 1982 and 1984 season values. Growth was determined from winter mean weights. Returns by weight were estimated by multiplying the harvest by mean weight.

RESULTS

Contribution of Planted Fish to the Fishery

From 1981 to 1985 planted lake trout have comprised from 13.5% to 67% of the seasonal lake trout harvest (average = 28%) (Table 3). In general, percent occurrence of planted fish in the creel was highest in winter. The actual degree of supplementation, expressed as a percentage of the native lake trout sample, ranged from 15.6% to 203.0%, with an

average of 40%.

Table 3. Contribution of planted lake trout to the Dickey Lake creel. The % supplementation is an estimate of the number of fish caught in addition to native fish, expressed as a percentage of the native sample.

Season	Total Sample	% Planted	% Supplementation
Winter 1981	63	67.0	203.0
Spring/Summer 1981	37	13.5	15.6
Winter 1982	69	33.3	49.9
Spring/Summer 1982	122	22.1	28.3
Winter 1983	135	24.4	32.3
Spring/Summer 1983	-	-	-
Winter 1984	52	17.3	20.9
Spring/Summer 1984	66	19.6	24.3
Winter 1985	142	29.9	42.7
Total	686	28.3	39.5

The relative percent occurrence of individual planted year-classes varied greatly (Table 4). The 1973 and 1974 planted year-classes (stocked in 1974 and 1975, respectively) contributed little to the fishery over the years 1981 to 1985. In winter 1981 the 1973, and 1974 year-classes were age 8 and age 7, respectively. Although these year-classes probably fully recruited to the fishery 2-3 years earlier the low returns in subsequent years suggest that these plantings were unsuccessful.

The 1976 year-class on the other hand contributed an estimated 588 fish to the fishery from 1981 to 1985 (Table 4). This represents a return of 36% of the original number of fish stocked. As partial recruitment probably occurred earlier than 1981, and the year-class

Table 4. Estimated angler harvest of individual planted year-class, the planting year is indicated in brackets (W=winter, Sp/Su=spring and summer).

Season	Est Harvest	% by year-class 73 (74)	74 (75)	76 (77)	80 (81)	81 (82)	82 (83)	Estimated Harvest by year-class 73 (74)	74 (75)	76 (77)	80 (81)	81 (82)	82 (83)
W81	366	3.2	1.6	61.9	0	0	0	12	6	227	0	0	0
Sp/Su81	193	0	0	13.5	0	0	0	0	0	26	0	0	0
W82	306	1.5	0	30.4	1.5	0	0	4	0	93	4	0	0
Sp/Su82	313	0	0	20.5	0	0	0	0	0	64	0	0	0
W83	306	0	0	21.5	0.7	1.5	0	0	0	66	2	5	0
Sp/Su83	263*	0	0	17.1*	3.1*	0	0	0	0	45	7	0	0
W84	283	0	0	3.9	11.5	0	0	0	0	11	33	0	0
Sp/Su84	212	0	0	13.6	6.1	0	0	0	0	29	13	0	0
W85	778	0	0.7	3.5	8.5	12.7	2.1	0	5	27	66	99	16
Total	3017	-	-	-	-	-		16	11	588	121	99	16

* estimated as the mean of Spring/Summer 1982 and 1984

still has the potential for further contribution, the total return could easily be 50%.

The 1980 year-class of hatchery fish (planted in 1981) was age four in the winter of 1984 and comprised approximately 12% of the anglers catch. In winter 1985 the percent composition had dropped slightly to 9% suggesting that the contribution of this year-class may be leveling off and the eventual return will be low. The expected returns of the 1981 planting cannot be properly evaluated, but the percent composition of 13 % at age 4 suggests a return rate similar to the 1980 planting. The unusually high harvest of lake trout in the winter of 1985, associated with very high effort that season (40% higner than the average of the four previous winters), probably accounts for the early appearance of a few planted fish of the 1982 year-class.

Age of Recruitment and Growth of Planted Fish

Planted lake trout are caught in very low numbers as young as age two during the first winter following planting (Table 4). The 1976 year-class peaked in abundance at age 5 (Figure 1) suggesting a full recruitment age of between five and six years for planted fish. Interestingly, the same cohort of native fish appeared to fully recruit a year later, at age 6 to 7 (Figure 1). There are insufficent data on age at recruitment of other planted year-classes to determine if this is a general phenomena. Later recruitment might be expected for slower growing fish. However, the native and planted year-classes had very similar growth rates (Figure 2).

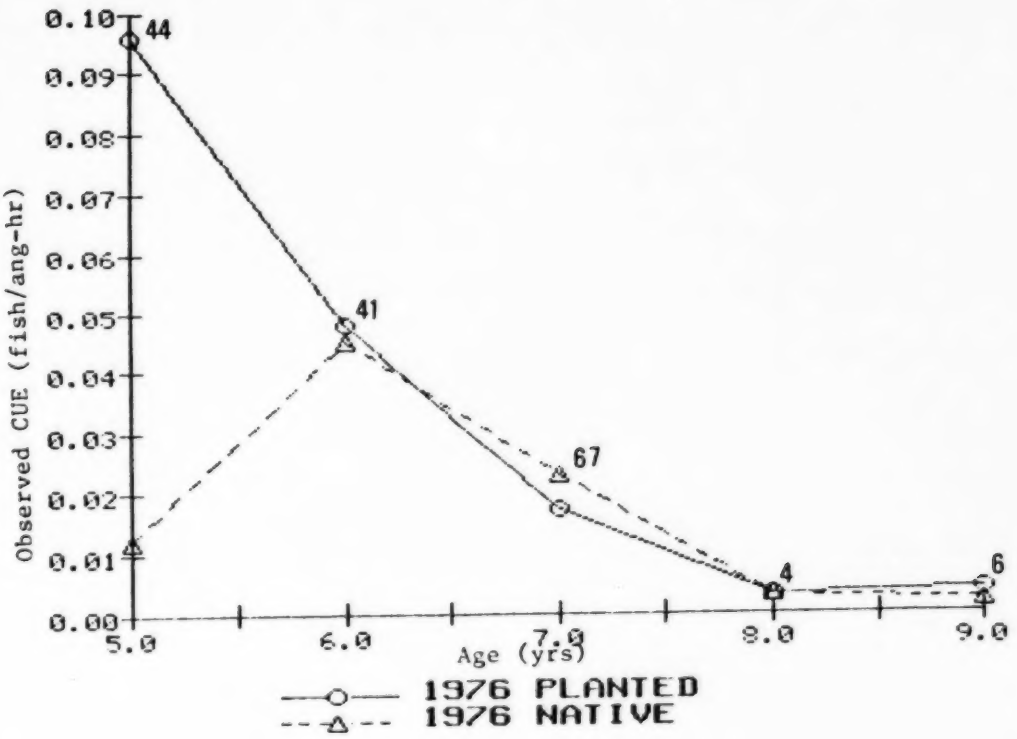

Figure 1. Catch curves for the 1976 year class of native and planted lake trout. The CUE values represent winter observed CUE's. The total observed number of fish is indicated above the symbols.

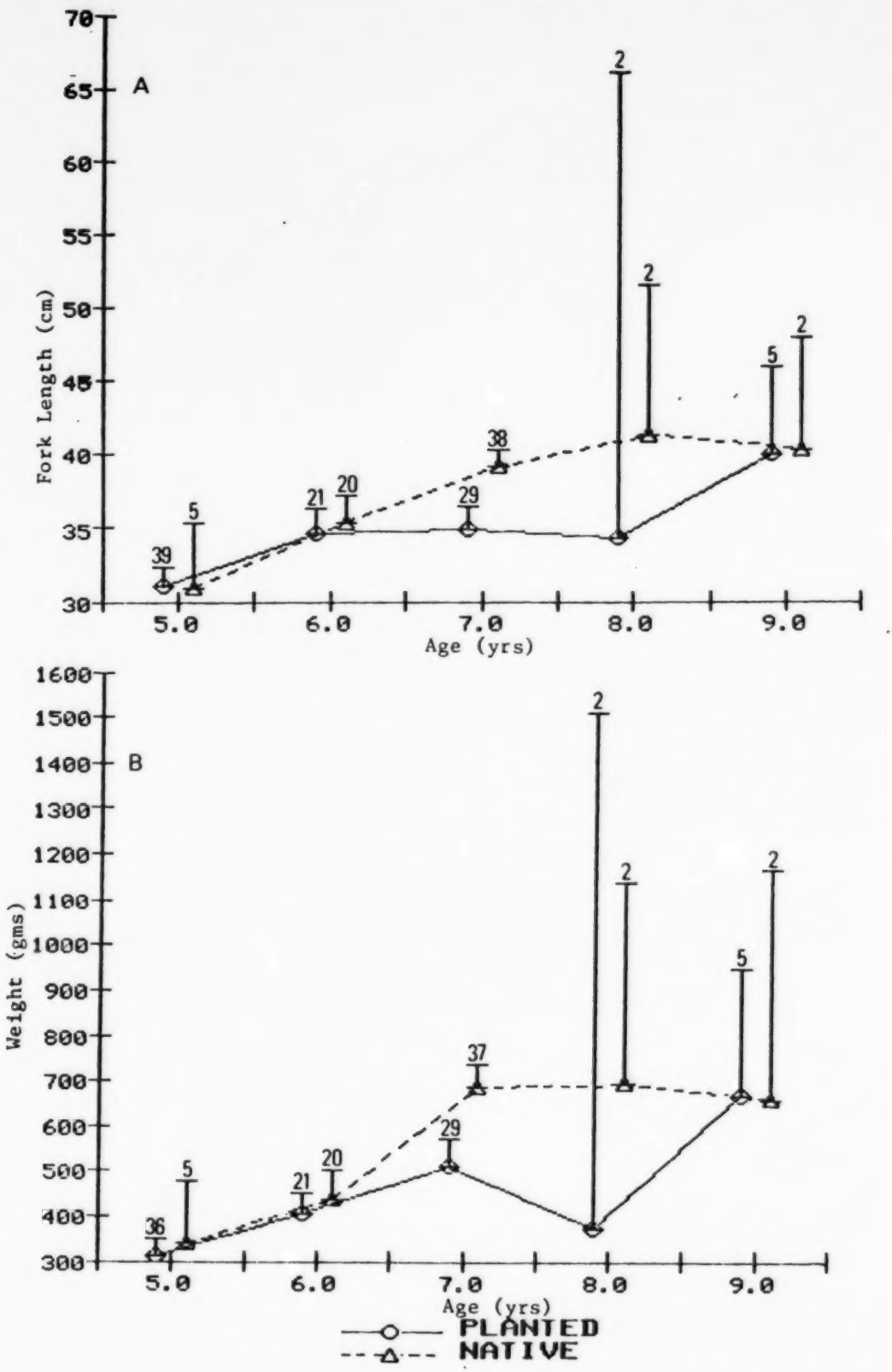

Figure 2. Growth in length (a) and weight (b) of the 1976 cohort of native and planted lake trout in Dickey Lake. Error bars represent the upper values of the 95 % confidence interval, sample sizes are indicated above the bars.

The growth of other planted year-classes, as determined by their size at age four and five, varied (Table 5). The 1976 and 1980 year-classes of Lake Manitou origin show similar growth with no significant differences between the length or weight at age five. The 1981 year-class of Lake Superior origin is slower growing with the length and weight at age four significantly smaller than the 1980 cohort ($p < .0005$), despite their larger size at planting. In general, between the ages four and six the planted lake trout grow 4-5 cm/yr fork length, and approximately 100 g/yr in weight (Table 5).

Table 5. Mean length and weight at age of planted lake trout. Sample size is in brackets.

	Length at Age			Weight at Age		
Cohort	4	5	6	4	5	6
1976	-	31.1 (39)	34.6 (21)	-	313 (36)	404 (21)
1980	26.6 (6)	30.5 (12)	-	181 (6)	293 (12)	-
1981	23.0 (19)	-	-	111 (19)	-	-

The Effect of Planted Fish on Angling Returns

The supplementation to the fishery provided by individual planted year-classes is of short duration in Dickey Lake. For example, both the cumulative harvest and cumulative yield of the 1976 year-class from 1981 to 1985 leveled off after three years, and appear to be approaching asymtopes of approximately 600 fish and 250 kg, respectively (Figure 3). By the end of 1983, 87% (520 fish) of the harvest, representing 92% (250 kg) of the yield was removed.

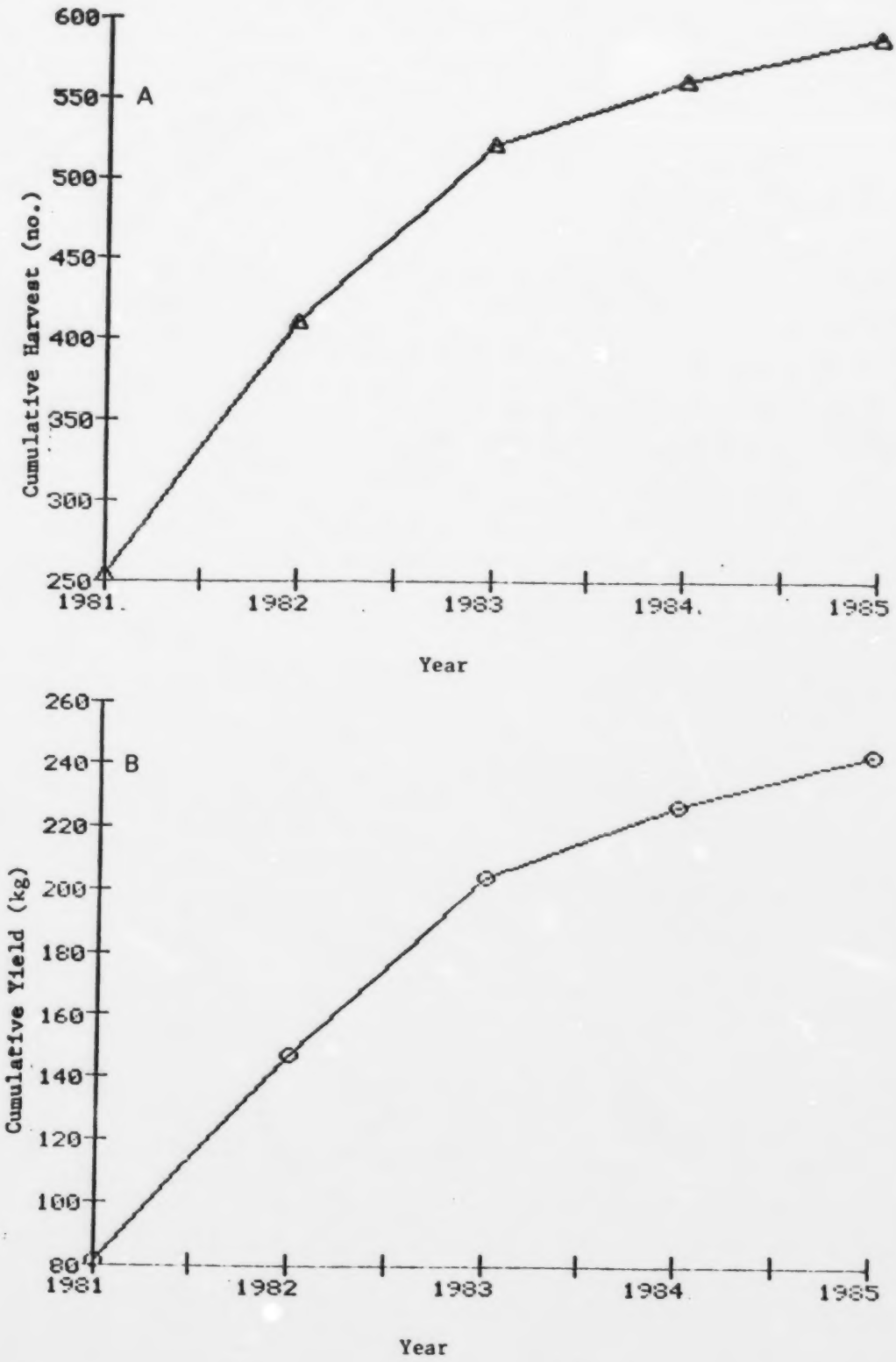

Figure 3. Cumulative harvest (a) and yield (b) of the 1976 year-class of planted lake trout. The cumulative harvest was tabulated from Table 4. Each year represents a winter, spring, and summer season except the 1985 season (winter only). Yield was calculated by multiplying the harvest by the annual mean weight of harvested fish of the 1976 year-class.

The recruitment of planted fish to the fishery provides catches of fish in addition to native fish. The percentage of planted fish in the creel is a direct measure of this supplementation. In other words, in the winter of 1981, planted fish increased the CUE and total harvest by 203% (Table 3).

The variation in the degree of supplementation provided by planted fish is a function of the variation in survival and recruitment of both planted and native year-classes. For example, a high percentage of planted fish in the fishery can result from either a low native fish abundance or a high planted fish abundance. Native and planted fish abundance, as measured by the observed winter CUE, seem to covary in Dickey Lake (Figure 4a). Delayed recruitment of the 1976 native year-class (Figure 1), accounts for the low native CUE in winter 1981 (Figure 4a).

An examination of the CUE of individual year-classes revealed that the covariance was due to a strong 1976 year-class of both native and planted fish. A plot of the CUE of these two cohorts combined, explains most of the variation in total CUE (Figure 4b). In Dickey Lake, most of the variation in angling returns over the period 1981-85 can be attributed to the changing abundance of a single year class of fish comprised of both native and hatchery stocks.

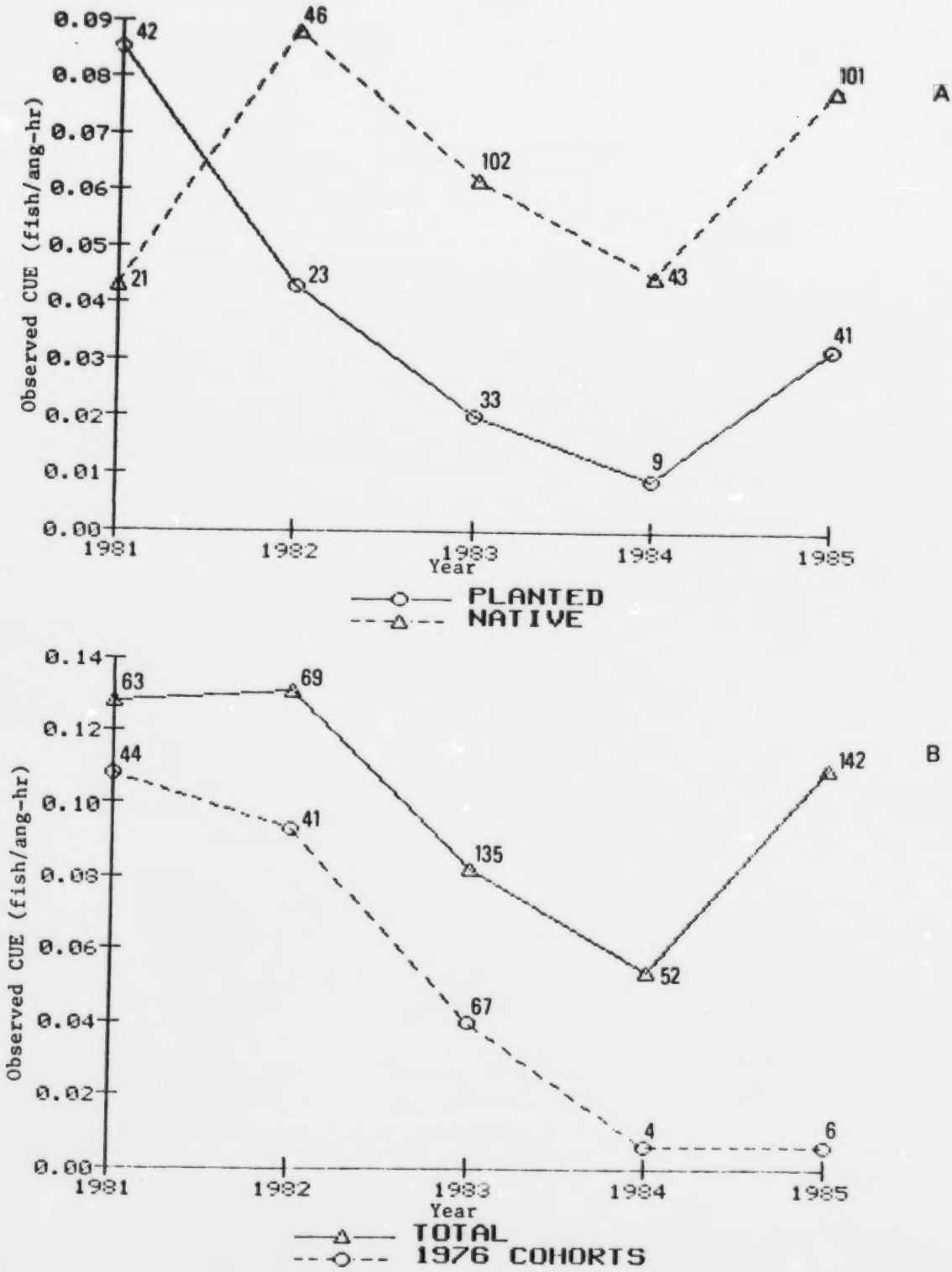

Figure 4. Variation in winter CUE of native and planted lake trout (a) and the variation in total winter CUE and the CUE of the 1976 planted and native year-classes combined(b). The observed number of fish is indicated above the bars.

SUMMARY STATISTICS

Table 6 provides a summary of returns rates (by number and weight) and other pertinent statistics for each of the planted year-classes. Individual year-classes contributed to the fishery over a broad range of ages, therefore, return rates are difficult to compare. Nonetheless, return rates ranged from 1.06% to 35.6% by number, and from 10% to 992% by weight.

Table 6. Return rates over 5 years (1981-85) and other summary statistics for lake trout planted in 1974 to 1983.

Planting year	1974	1975	1977	1981	1982	1983
Year class	1973	1974	1976	1980	1981	1982
Ages in fishery	8-12	7-11	5-9	2-5	2-4	2
Number planted	1250	800	1650	1550	1500	1500
Rate (no./ha)	5.8	3.7	7.7	7.2	7.0	7.0
Return (no./ha)	0.07	0.05	2.7	0.58	0.46	0.07
Return (%, no.)	1.28	1.38	35.63	8.00	6.60	1.06
Mean wt. (g)	11.4	11.4	15.1	12.5	21.4	15.1
Gross wt. (kg)	14.25	9.12	24.92	19.38	32.12	22.65
Rate (kg/ha)	0.07	0.04	0.12	0.09	0.15	0.11
Return (kg/ha)	0.06	0.07	1.19	0.15	0.05	0.01
Return (%, wt.)	86	175	992	166	33	10

DISCUSSION

Over the study period, hatchery lake trout have supplemented the fishery of Dickey Lake successfully. Much of this success can be attributed to the phenomenal returns of the 1976 planted year-class. The high returns of the 1976 year-class may be related to the larger mean weight at planting relative to that for other plants in adjacent years (Table 2). Smaller sized fish of Lake Manitou and Lake Superior origin planted in 1974 and 1975 resulted in few returns, while the 1980 planted year-class of smaller Lake Manitou fish resulted in only moderate returns (Table 4). Several year-classes of Lake Manitou stock of the same or larger size as the 1976 year-class and a planting of larger-sized, slow-growing Lake Superior stock are expected to fully recruit to the fishery over the next five years. If the returns are similar to the 1976 year-class, the short term prognosis for the Dickey Lake fishery is good.

The observation of the strong 1976 native year-class may be unrelated to the strength of the 1976 planted year-class. Alternatively, it may suggest that year-class strength of both native and planted lake trout in Dickey Lake is determined by factors affecting the survival of post-yearling populations. Mechanisms may be cannibalism and competition, such that strong year-classes of both native and planted fish occur when the abundance of other year-classes of trout are low. The strong 1976 year-class was coincident with a hiatus in stocking for three years. However, lake trout stomach content

samples collected during creel surveys have not shown any evidence of cannibalism, and competition cannot be assessed with current data.

Many alternative explanations could be offered for the variation in planted fish survival, but there is insufficient information on which to base an assessment. An important determinant of survival may be handling stress prior to stocking. A measure of fish condition, perhaps from short term in situ bioassays may explain a large proportion of the variation in survival of different plantings. The interpretation of planted fish returns is also complicated by variation in the quality of fin clipping and variable rates of clipped-fin regeneration. In fact, poor fin clip quality or extensive regeneration resulting in a failure to recognize planted fish could partially explain the apparent correlation between the 1976 "native" and planted year-class abundance. Routine documentation of the quality of fin clipping is necessary to enhance the utility of stocking assessments.

Lake trout stocking assessments that derive measures of growth and survival, for example, Powell et al (1986), are extremely valuable. However, returns of planted lake trout to a sport fishery are determined not only from growth and survival, but also from recruitment, catchability, and fishing effort. Continual creel surveys are the only way to integrate these variables and provide direct management information.

Lake trout stocking assessments that measure actual returns to the sport fishery are rare (see Potter et al. 1982). Purych (1977) reviewed

eight years of lake trout creel data for Flack Lake, and estimated the return rates of three planted year-classes at less than 1.0% by number, and from 12% to 53% by weight. MacLean et al. (1981) reported returns of planted lake trout to the winter angling fishery on Lake Simcoe. From these data I calculated total return rates summed over four winters to range from 0.5 to 8.4% by number. The limited representation (1-5 years) of some year-classes in this study, suggests that Dickey Lake returns were considerably higher than either Flack Lake or Lake Simcoe. A possible explanation for the low returns from Flack Lake was the smaller size at planting (3.8 to 7.5 grams, Purych 1977).

For fisheries similar to Dickey Lake, a minimum of five years of continuous creel survey are required to assess a maximum of three planted year-classes (assuming annual lake trout stocking). This study was limited to a reasonably complete assessment (5 years of contribution to the fishery) of only the 1977 planting. If lake trout had been planted in 1976, and 1978, the data series would have provided four years of assessment information for an additional two year-classes. Intermittent creel surveys, as proposed in the "maintenance phase" of the assessment unit core program (Anonymous 1986) will severly limit future lake trout stocking assessments.

Direct experimentation with various aspects of stocking (densities, strains, weights, stocking methods, annual frequencies etc.) in assessment unit lakes has great potential. Changes in stocking practices are ideally suited to an experimental management approach (see

SPOF WG no. 3, Ontario 1978) since they do not require regulatory changes, and are easy to implement and monitor. Examples of experimental manipulations that may be appropriate for Dickey Lake include:

1) Plant larger sized lake trout, perhaps from cage culture experiments.
2) Cease stocking for 5-6 years or stock every year and monitor the changes in fishing effort, harvest and the response of native fish populations.
3) Stock the lake every 3 or 4 years instead of annually.
4) Drastically change (increase or decrease) stocking densities.
5) Introduce experimental varieties of hatchery trout.

Consideration should be given to the above proposals when determining management options for Dickey Lake.

SUMMARY

1) From 1981-85, planted fish have comprised 13.5% to 67.0% of the seasonal harvest as determined from fin clip data.
2) The returns of planted lake trout from 1974 and 1975 plantings were low (1%,3% by number, 86%,175% by weight)
3) It is estimated that from January 1981 to March 1985 anglers caught 36% of the total number of lake trout planted in 1977, representing a return by weight of approximately 10 fold. Actual returns may have approached 50%.

4) Higher return rates may have been associated with larger mean size at planting.

5) Planted lake trout appeared in the creel as early as the first winter following planting. Limited data suggested that full recruitment occurred in the fourth winter following planting when the lake trout were five years old. Similarly sized native fish recruited one year later than the same year-class of planted fish.

6) Between the ages of four and six, planted lake trout grow 3-4 cm/yr in fork length and approximately 100 grams in weight/yr.

7) Growth of planted lake trout of Lake Superior origin was slower despite larger size at planting.

8) Individual cohorts of planted lake trout supplemented the fishery for about three years, following full recruitment.

9) Most of the variation in the returns of native and planted fish can be explained by the changing abundance of a strong 1976 year class of both native and planted fish.

10) Future stocking assessments could benefit from,

   a) a knowledge of fin clip quality and estimates of the degree of fin clip regeneration.

   b) alternatives to fin clipping as a method of recognizing planted fish.

   c) Measurement of length and weight of individual planted fish to facilitate statistical comparison of variation in

length, weight and condition factor at the time of planting.

d) descriptions of transportation and planting methods, and observation of the condition of fish at the time of planting.

CONCLUSION

Stocking assessment is a by-product of fisheries assessment. In Dickey Lake it provided useful information concerning variation in growth and survival of individual plantings, furthered our understanding of how variation in the angling returns is influenced by planted fish, and hinted at common determinants of native and planted fish survival. Similar information from other lakes would assist with the development of guidelines concerning stocking practices. Thus, more attention should be given to the role of asessments units in providing purposive, cost-effective, and timely stocking assessments.

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